Available online at *www.ujpronline.com*
Universal Journal of Pharmaceutical Research
An International Peer Reviewed Journal
ISSN: 2831-5235 (Print); 2456-8058 (Electronic)

RESEARCH ARTICLE

KNOWLEDGE AND ATTITUDE TOWARD CONE BEAM COMPUTED TOMOGRAPHY: A QUESTIONNAIRE STUDY AMONG YEMENI DENTAL PRACTITIONERS

Mohammed M AlKhawlani[1*], Tariq A Ziad[2], Ammar A Daer[3,4], Najla A Alwashali[5], Bushra M Abdulaziz[6], Abeer A Al-Sosowa[7,8]

[1]*Conservative Department, Faculty of Dentistry, Thamar University, Dhamar, Yemen.* [2]*Private Dental Clinic, Sana'a, Yemen.*
[3]*Post doctorate Fellow at Faculty of Dentistry, McGill University, Montreal, Canada.*
[4]*Department of Orthodontic, Faculty of Dentistry, Sana'a University, Sana'a, Yemen.*
[5]*Department of Oral Pathology, Faculty of Dentistry, Thamar University, Dhamar, Yemen.*
[6]*Department of Orthodontic, Faculty of Dentistry, Thamar University, Dhamar, Yemen.*
[7]*Department of Periodontics, School of Stomatology, Lanzhou University, Lanzhou, China.*
[8]*Department of Periodontics, Faculty of Dentistry, Thamar University, Dhamar, Yemen.*

Article Info:

Article History:
Received: 1 December 2021
Reviewed: 5 January 2022
Accepted: 9 February 2022
Published: 15 March 2022

Cite this article:
AlKhawlani MM, Ziad TA, Daer AA, Alwashali NA, Abdulaziz BM, Al-Sosowa AA. Knowledge and attitude toward cone beam computed tomography: a questionnaire study among Yemeni dental practitioners. Universal Journal of Pharmaceutical Research 2022; 7(1):50-55. ***https://doi.org/10.22270/ujpr.v7i1.723***

***Address for Correspondence:**
Dr. Mohammed M. AlKhawlani, Conservative Department, Faculty of Dentistry, Thamar University, Dhamar, Yemen.
Tel- +967774757074;
E-mail: *khawlani5@yahoo.com*

Abstract

Background: Cone beam computed tomography (CBCT) is a marvelous three-dimensional (3D) dental and maxillofacial imaging method industrial in recent years. It is based on a multi-surface resampling process that has distinct advantages such as condensed radiated area size, image resolution, fast scanning time, exclusive maxillofacial imaging patterns and reduced image errors.
Objectives: This study aimed to evaluate the knowledge and attitude of a sample of Yemeni dentists toward the use of CBCT.
Methods: A total of 98 selected dentists participated in this study. The self-administered questionnaires, consisting of two parts, were distributed: The first is related to the demographic characteristics and the second section is related to the knowledge and attitude of the dental practitioners towards CBCT. The study was conducted in Dhamar city, Yemen.
Results: The majority of respondents were 86 general dental practitioners (87.8%), most of whom were working in private dental clinics. More than half of the participants (67.3%) used digital imaging techniques to take radiographs. The most frequent source of knowledge about respondents' digital imaging techniques was the Internet (39%). Awareness of CBCT was higher in dentists, dental specialists, and those who were in an academic position. Lower radiation dose (26%), followed by secure image processing (23%), and short scanning time (21%) were the most common advantages of CBCT reported by the respondents.
Conclusion: Study participant responses reflect the importance of CBCT in the dental field. Awareness about CBCT among dentists in Yemen is good and appears to be different among dentists with regard to gender, qualifications and type of work. The study requires that continuing learning courses be held in dental colleges in Yemen including appropriate hands-on CBCT training and integration with other clinical courses to improve the dentist's basic knowledge and interpretation regarding this technology.
Keywords: Attitude, CBCT, dental practitioners, knowledge, Yemen.

INTRODUCTION

Since 1896, radiography has formed an important part of the clinical assessment, diagnosis and treatment of dental patients[1]. Two-dimensional (2D) radiographic images have been used in dentistry for decades, basically Intraoral, panoramic and cephalometric radiographs. Due to the complex 3 dimensional (3D) anatomy of the oral and maxillofacial region, the traditional dental modalities may fail to provide optimal visualization of adjacent overlying structures, which can get superimposed in any projection, this has resulted in many efforts to obtain 3D radiography and overcome the limitations of 2D imaging[2]. The invention of computed tomography (CT) in 1979 is considered to be the greatest innovation in the field of

radiology, providing cross-sectional images with a better insight of the structures of the body and lesions, thereby increasing the chances of recovery. However, its application in dentistry is considered limited because of its high cost, access, and radiation dose considerations[3]. In the late 1990s, Arai *et al*., and Mozzo *et al*., independently introduced cone beam computed tomography (CBCT) scanners for the oral and maxillofacial (OMF) region as an alternative to conventional CT[2]. One benefit of CBCT technology, its ability to provide sub-millimeter (0.1mm or even less) resolution in terms of images[4]. The images provided are also high in diagnostic quality[1,2]. Moreover, CBCT has several advantages over conventional CT making it the first choice among dental professionals, including reduced cost and space requirements, a more rapid scanning time, limit the beam to the head and neck, reduction in the radiation doses, the ability to take different images from a certain structure and the possibility of reconstructing sagittal and coronal views[4-7]. However, CBCT gives increased radiation doses to patients compared with conventional dental radiographic techniques[8]. Other disadvantages of CBCT are the low resolution of its soft tissue and scattering beams from tooth tissue[7].

Previous studies showed that the effective radiation dose of CBCT ranged between 0.035 and 0.10 µSv, which is equivalent to approximately a full mouth series of periapical or 3-10 standard dental panoramic tomography. The above dose is up to a 98% lower compared to conventional CT, being about 0.4 µSv[1,9]. In spite of the fact that the dose and the cancer risk from dental CBCT are almost negligible for an individual patient, extensive use of radiation covering large populations should not be allowed without proper justification, with a specific focus on children. The justification step is often the most efficient step for patient dose reduction. One of the important factors in CBCT optimization is the selection of an appropriate field of view (FOV) according to clinical indication[2,10]. Common indications for CBCT in dentistry are implantation, orthodontic treatments, assessment of temporo-mandibular joint, proximity of third mandibular molar with inferior alveolar nerve previous to extraction, planning orthognathic surgery and endodontic review[5,7,11]. Also, CBCT has been indicated in craniofacial clinical practice for diagnosing as well as pre-surgical planning of different types of acquired and congenital craniofacial malformations, like; cleft palate, facial trauma, root fractures, inflammatory bony changes and benign and malignant tumors[12]. In addition, CBCT imaging can assess airway shape and volume in patients with obstructive sleep apnea (OSA)[13].

It has been recommended that CBCT should be performed as an auxiliary imaging technique. However, due to a lack of strict guidelines and ignorance about the role of CBCT in dentistry, it has become a substitute for conventional radiography, including periapical, bitewing, and panoramic radiographs[2,6,14]. Some criteria have been laid down by the American Academy of Oral and Maxillofacial Radiology for the role of CBCT in implants, endodontics, and orthodontics[14]. The American Dental Association Council on Scientific Affairs Council has encouraged CBCT operators to contribute in continuing education courses in order to ensure that practitioners have a satisfactory understanding of radiation safety in the dental care setting. So, CBCT imaging should only be recommended by a clinician who has undergone appropriate training in CBCT radiology and exhibits an acceptable knowledge concerning the applications of CBCT, along with experience in the interpretation of CBCT images and an appreciation of the limitations of CBCT[2,15]. The aim of this survey was to assess awareness, knowledge and attitude among dentists in Yemen towards CBCT use.

MATERIALS AND METHODS

A total of 120 self-administered questionnaires were distributed to dental practitioners in, Dhamar city, Yemen. The questionnaires were printed and disseminated personally by the authors. The questionnaire was adopted from some previous studies[16,17]. Only completely filled-in questionnaires were included in the analyses. The questionnaire consisted of two main sections. The first is related to the demographic characteristics including: gender, qualification, year of graduation, and type of work. The second section is related to the main objective of the study (CBCT) including 2 parts relating to knowledge and attitude of the dental practitioners towards CBCT. In the knowledge part dentists were asked the use or order of digital imaging, reason for not ordering digital imaging, and their awareness of CBCT in dental radiology. In the attitude part dentists were asked about attending courses related to CBCT, advising CBCT in their dental practice. Data were presented in the terms of frequencies and percentages. The statistical package for social sciences (SPSS V25) was used for analyzing the data.

RESULTS

A total of 98 dentists (53.1% male and 46.9% female) participated in this study (response rate 82%). Among them, 86 (87.8%) were general dental practitioners and 12 (12.2%) were specialists. About half of respondents (52.0%) were working in private dental clinics, 12.2% in academic positions, 17.3% in more than one, and 9.2% in governmental or none, of an equal position (Table 1).

Table 1: Characteristics of the study sample.

Gender		
Male	52	53.1
Female	46	46.9
Qualification		
Bachelor	86	87.8
Specialist	12	12.2
Place of work		
Private	51	52.0
Academic	12	12.2
Governmental	9	9.2
Combined	17	17.3
None	9	9.2

More than half of the respondents (67.3%) used digital imaging techniques to obtain radiographs. The main reason why respondents did not request digital imaging is its high cost (59.4%) (Table 2), while the main reasons for requesting were a lower radiation dose (26%), followed by a short time (24%) (Figure 1).

Table 2: Knowledge of dental practitioners about CBC.

Use/Order digital imaging modalities	
Yes	66 (67.3)
No	32 (32.7)
Reasons of not using/ordering digital image	
Expensive	19 (59.4)
Do not know how to use computer	5 (15.6)
Hard to perform	2 (6.3)
No idea	6 (18.8)
Aware of CBCT in dental radiology	
Yes	66 (67.3)
No	32 (32.7)
Believe that CBCT will be used in routine dental practice	
It will not be used	3 (4.5)
In all specialties of dentistry	30 (45.5)
Limited use	12 (18.2)
Selected dental applications only	16 (24.2)
No idea	5 (7.6)

About two thirds (67.3%) of respondents were familiar with CBCT at dental radiology. The Internet was the most frequent source reported by respondents (39%), followed by lessons by faculty (26%), and seminars or workshops (25%) (Figure 2).

Table 3: Attitude of dental practitioners toward CBCT.

Having CBCT in the dental institution	
Yes	78 (79.6)
No	20 (20.4)
Attended courses related to CBCT	
Yes	22 (22.4)
No	76 (77.6)
Willing to attend courses related to CBCT	
Yes	62 (63.3)
No	10 (10.2)
Maybe	26 (26.5)
Advised CBCT for diagnosis	
Yes	47 (48.0)
No	51 (52.0)
Like to use CBCT in future	
Yes	69 (70.4)
No	1 (1.0)
Maybe	23 (23.5)
No idea	5 (5.1)
Adequate teaching given to undergraduate students	
Yes	37 (37.8)
No	61 (62.2)
CDE/Workshops should be conducted	
Yes	45 (45.9)
No	5 (5.1)
Maybe	48 (49.0)

Most respondents (79.6%) claimed that they have CBCT in their dental institution and about 77.6% did not attend courses related to CBCT while 63.3% were willing to attend such courses in future. Less than half of respondents (48.0%) advised CBCT for diagnosis while, 70.4% liked to use CBCT in future.

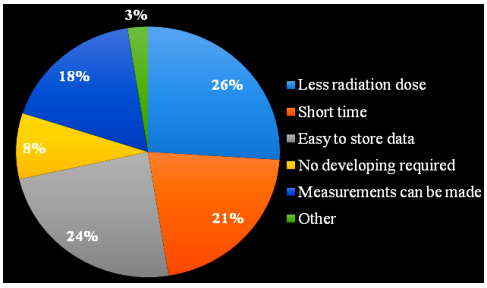

Figure 1: Responses of dentists to the reasons for use digital imaging.

More than 60% of respondents claimed that no adequate teaching relating to CBCT was given to undergraduate students and less than 50% believed that workshops should be conducted for it (Table 3).

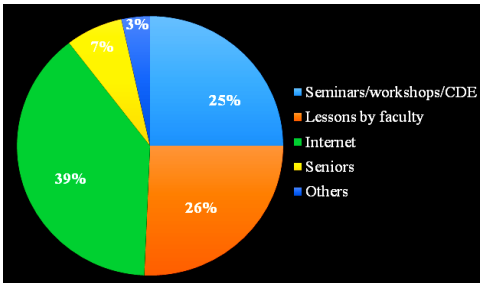

Figure 2: Sources of knowledge about the term CBCT.

The most frequently advantages of CBCT cited by respondents were lower radiation dose (26%), followed by easy image processing (23%), and short scanning time (21%) (Figure 3).

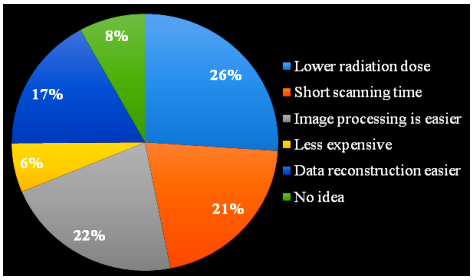

Figure 3: Advantages of CBCT over other modalities according to dentists' opinions.

Implant dentistry and evaluation of cyst and tumors, equally (23%), followed by evaluation of impactions (19%) were the most cases for which dentists will use CBCT in future (Figure 4). Table 4 shows the dentists' responses to some CBCT questions distributed by gender, qualification, and type of work. Male dentists, dental specialists, and those who were in academic position were more aware of CBCT in dental radiology and used/ordered more digital imaging modalities. While, male dentists, dental specialists, and those who had more than one work position attended more courses related to CBCT.

Table 4: Responses of dental practitioners to some questions related to CBCT.

		Aware of CBCT in dental radiology		Adequate teaching given to undergraduate students		Attended courses related to CBCT		Use/Order digital imaging modalities	
		Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Gender	Male	40 (76.9)	12 (23.1)	17 (32.7)	35 (67.3)	16 (30.8)	36 (69.2)	38 (73.1)	14 (26.9)
	Female	26 (56.5)	20 (43.5)	20 (43.5)	26 (56.5)	6 (13.0)	40 (87.0)	28 (60.9)	18 (39.1)
Qualification	Bachelor	54 (62.8)	32 (37.2)	34 (39.5)	52 (60.5)	17 (19.8)	69 (80.2)	56 (65.1)	30 (34.9)
	Specialist	12 (100.0)	0 (0.0)	3 (25.0)	9 (75.0)	5 (41.7)	7 (58.3)	10 (83.3)	2 (16.7)
Working status	Private	38 (74.5)	13 (25.5)	18 (35.3)	33 (64.7)	12 (23.5)	39 (76.5)	34 (66.7)	17 (33.3)
	Academic	11 (91.7)	1 (8.3)	4 (33.3)	8 (66.7)	3 (25.0)	9 (75.0)	10 (83.3)	2 (16.7)
	Governmental	4 (44.4)	5 (55.6)	2 (22.2)	7 (77.8)	0 (0.0)	9 (100.0)	2 (22.2)	7 (77.8)
	Combined	9 (52.9)	8 (47.1)	7 (41.2)	10 (58.8)	5 (29.4)	12 (70.6)	14 (82.4)	3 (17.6)
	None	4 (44.4)	5 (55.6)	6 (66.7)	3 (33.3)	2 (22.2)	7 (77.8)	6 (66.7)	3 (33.3)

Table 5: Distribution of dentists' opinions about the use of CBCT in dental practice according to gender, qualification, and work.

		Believe that CBCT will be used in routine dental practice				
		It will not be used	In all specialties of dentistry	Limited use	Selected dental applications only	No idea
Gender	Male	2 (5.0)	20 (50.0)	7 (17.5)	7 (17.5)	4 (10.0)
	Female	1 (3.8)	10 (38.5)	5 (19.2)	9 (34.6)	1 (3.8)
Qualification	Bachelor	2 (3.7)	25 (46.3)	9 (16.7)	13 (24.1)	5 (9.3)
	Specialist	1 (8.3)	5 (41.7)	3 (25.0)	3 (25.0)	0 (0.0)
Working status	Private	3 (7.9)	19 (50.0)	6 (15.8)	8 (21.1)	2 (5.3)
	Academic	0 (0.0)	5 (45.5)	2 (18.2)	4 (36.4)	0 (0.0)
	Governmental	0 (0.0)	0 (0.0)	1 (25.0)	2 (50.0)	1 (25.0)
	Combined	0 (0.0)	5 (55.6)	1 (11.1)	2 (22.2)	1 (11.1)
	None	0 (0.0)	1 (25.0)	2 (50.0)	0 (0.0)	1 (25.0)

Responses to the question related to the teaching given to undergraduate students, almost all dentists respond negatively that the teaching of CBCT was not enough. Regarding dentists' opinions about the future use of CBCT in dental practice, the majority of responses were toward the use of CBCT in all specialties of dentistry (Table 5). Male dentists, dental specialists, and dentists in academic, governmental and combined positions agreed that CBCT workshops should be conducted while, majority of responses by gender, qualification, and type of work were toward the use of CBCT in future. However, in response to the question related to the advice of CBCT for diagnosis, female dentists, general dental practitioners, and dentists in private, academic, and governmental positions did not advise CBCT for diagnosis in their dental practice (Table 6).

Table 6: Distribution of dentists' opinions and attitude toward the use of CBCT.

		CDE/Workshops should be conducted			Like to use CBCT in future				Advised CBCT for diagnosis	
		Yes (%)	No (%)	Maybe (%)	Yes (%)	No (%)	Maybe (%)	No idea (%)	Yes (%)	No (%)
Gender	Male	24 (46.2)	4 (7.7)	24 (46.2)	37 (71.2)	0 (0.0)	11 (21.2)	4 (7.7)	30 (57.7)	22 (42.3)
	Female	21 (45.7)	1 (2.2)	24 (52.2)	32 (69.6)	1 (2.2)	12 (26.1)	1 (2.2)	17 (37.0)	29 (63.0)
Qualification	Bachelor	35 (40.7)	5 (5.8)	46 (53.5)	59 (68.6)	1 (1.2)	22 (25.6)	4 (4.7)	40 (46.5)	46 (53.5)
	Specialist	10 (83.3)	0 (0.0)	2 (16.7)	10 (83.4)	0 (0.0)	1 (8.3)	1 (8.3)	7 (58.3)	5 (41.7)
Working status	Private	19 (37.3)	4 (7.8)	28 (54.9)	35 (68.6)	1 (2.0)	13 (25.5)	2 (3.9)	23 (45.1)	28 (54.9)
	Academic	7 (58.3)	0 (0.0)	5 (41.7)	8 (66.7)	0 (0.0)	2 (16.7)	2 (16.7)	5 (41.7)	7 (58.3)
	Governmental	6 (66.7)	0 (0.0)	3 (33.3)	5 (55.6)	0 (0.0)	4 (44.4)	0 (0.0)	4 (44.4)	5 (55.6)
	Combined	11 (64.7)	1 (5.9)	5 (29.4)	14 (82.4)	0 (0.0)	3 (17.6)	0 (0.0)	11 (64.7)	6 (35.3)
	None	2 (22.2)	0 (0.0)	7 (77.8)	7 (77.8)	0 (0.0)	1 (11.1)	1 (11.1)	4 (44.4)	5 (55.6)

DISCUSSION

Studies assessing awareness, knowledge and attitude of CBCT among dentists and specialists are rare. This study used a questionnaire to assess the level of knowledge regarding CBCT among a sample of Yemeni dentists and specialists. Correct diagnosis and treatment planning of patients seeking various dental procedures sometimes need several radiographic imaging techniques[16,17]. Among those radiographic techniques, CBCT has been shown to have a wide application in dentistry[18,19]. This study showed that more than half of respondents (67.3%) were aware of CBCT. In contrast, a higher percentage was published by Rai *et al.*[20], in their study among Indian dentists and a lower percentage were obtained by Aditya *et al.*[21], who reported that low awareness regarding applications of CBCT among practitioners causes widely less use of CBCT in clinical practice[20,21]. They reported that the majority of their participants did not advice CBCT at all or advice in less than one-fourth of their cases. This could be due to low availability of the technique,

high cost or inability of case selection for CBCT imaging by the dentists[21]. The current study revealed that, the main reasons for ordering CBCT were less radiation dose (26%) followed by short time (24%). This was in agreement with the findings published by Rai *et al.*[20], and also Chau and Fung[22] who mentioned that CBCT causes the lowest radiation dose to the organs. A higher value was recorded by Balabaskaran and Srinivasan in which 80.48% of participants revealed that the most advantage of CBCT over CT was the lower radiation. About 87.8% revealed that CBCT offers enhanced diagnosis at a lower dose than CT[23].

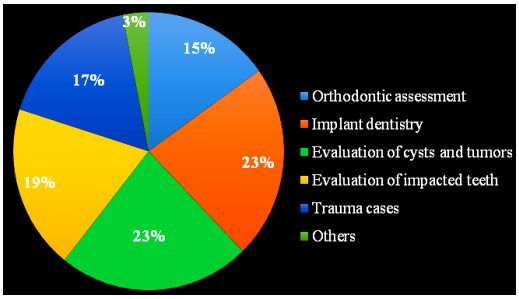

Figure 4: Cases toward dentists will use CBCT in their future career.

Male dentists, dental specialists, and those who were in academic position were more aware of CBCT in dental radiology and used/ordered more digital imaging modalities. About two thirds (67.3%) of the respondents were aware of CBCT in dental radiology. To a great extent, similar findings were seen in Turkey, Middle East, and India by Kamburoglu *et al.*[24], Zain Alabdeen, and El Khateeb[25] and Rai *et al.*[20], respectively. Other studies showed less awareness amongst the dentists regarding applications of CBCT in India which could be due to lack of availability of CBCT centers and non-inclusion of CBCT training during dental education[21,26,27]. In Turkey, Kamburoglu *et al.*, noted in their study among Turkish dental students that there was a very low awareness about CBCT[24]. The Internet was the most frequent source reported by respondents (39%), followed by lessons by faculty (26%), and seminars or workshops (25%). Male dentists, dental specialists, and those who had more than one work position attended more courses related to CBCT. Higher percentages were reported by Rai *et al.*[20], (72.2%) and Balabaskaran and Srinivasan[23] (48%) among the dentists who obtained knowledge about CBCT through lectures. Kamburoglu K *et al.*[24], claimed that, 63.3% of students had heard of CBCT, 59.9% of them had learned about CBCT in their classes, 31.0% in seminars and 20.9% from the internet. In contrast, Zain-Alabdeen and El-Khateeb[25] reported that the source of CBCT knowledge was postgraduate training in Saudi Arabia and Egypt, whereas in Jordan, it was seminars and workshops. In Turkey, the main source of CBCT knowledge for dental students was seminars; however, the rating for CBCT courses was poor in the study[24].

In this study, more than 60% of respondents claimed that no adequate teaching relating to CBCT was given to undergraduate students and less than 50% believed that workshops should be conducted with this regard. Responses to the question related to the teaching given to undergraduate students, almost all dentists respond negatively that the teaching of CBCT was not enough for undergraduate students. This is in line with the findings obtained by Rai[20], and Aditya *et al.*, among Indian dentists. In contrast, Kamburoglu *et al.*[24], in their study revealed slight higher percentage in which 76.8% felt that CBCT was not covered enough in their courses and 69% thought that CBCT should be taught as part of their clinical education; 91% thought that CBCT should be available at dental faculties. Zain-Alabdeen and El-Khateeb[25] suggested the development of Curriculum and incorporate CBCT training in undergraduate studies.

In our study, less than half of respondents (48.0%) advised CBCT for diagnosis while, 70.4% liked to use CBCT in future. Female dentists were less likely to advice CBCT than male dentists. This might be attributed to the fact that the number of female specialists is lower than male ones. Moreover, females are less likely to perform complicated cases which require more investigations[28]. Implant dentistry and evaluation of cyst and tumors, equally (23%), followed by evaluation of impactions (19%) were the most cases for which dentists will use CBCT in future. These findings were in accordance with Rai *et al.*[20], Balabaskaran and Srinivasan[23]. Zain-Alabdeen and El-Khateeb[25] reported that implant was the indication with the highest frequency, followed by impaction and jaw pathology at equal frequency and then TMJ and endodontic. A study done by Strindberg *et al.*[29], in Sweden showed that implant was the indication with the highest frequency and impaction was the second highest indication, followed by jaw pathology, and a pain related condition. Most of the relevant studies reported that CBCT is used mostly for implants[20-25,29]. Regarding dentists' opinions about the future use of CBCT in dental practice, the majority of responses were toward the use of CBCT in all specialties of dentistry which was in harmony with most of other studies. Many studies showed that dentists wanted to use CBCT technology in the near future in their clinical practice[20,23,24].

CONCLUSIONS

Study participant responses reflect the importance of CBCT in the dental field. Awareness about CBCT among dentists in Yemen is good and appears to be different among dentists with regard to gender, qualifications and type of work. The study requires that continuing learning courses be held in dental colleges in Yemen including appropriate hands-on CBCT training and integration with other clinical courses to improve the dentist's basic knowledge and interpretation regarding this technology.

ACKNOWLEDGEMENT

The authors would like to acknowledge all dentists who participated in this study.

AUTHOR'S CONTRIBUTION

AlKhawlani MM: writing original draft, methodology. **Ziad TA:** research design, data collection. **Daer AA:** statistical analysis, conceptualization. **Alwashali NA:** editing, methodology. **Abdulaziz BM:** methodology, investigation. **Al-Sosowa AA:** supervision. Final manuscript was read and approved by all authors.

DATA AVAILABILITY

Data will be made available on reasonable request.

CONFLICT OF INTEREST

None to declare.

REFERENCES

1. Macleod I, Heath N. Cone-beam computed tomography (CBCT) in dental practice. Dent Update 2008; 35:590-592, 594-598. *https://doi.org/10.12968/denu.2008.35.9.590*
2. Kiljunen T, Kaasalainen T, Suomalainen A, *et al*. Dental cone beam CT: A review. Phys Med 2015; 31:844-860. *https://doi.org/10.1016/j.ejmp.2015.09.004*
3. Kalender WA: Computed tomography: fundamentals, system technology, image quality, applications. John Wiley & Sons, 2011.
4. Scarfe WC, Farman AG, Sukovic P. Clinical applications of cone-beam computed tomography in dental practice. J Can Dent Assoc 2006; 72:75-80. *https://doi.org/10.1016/j.jds.2021.10.013. Epub 2021 Nov 3*
5. De Vos W, Casselman J, Swennen GR. Cone-beam computerized tomography (CBCT) imaging of the oral and maxillofacial region: a systematic review of the literature. Int J Oral Maxillofac Surg 2009; 38:609-625. *https://doi.org/10.1016/j.ijom.2009.02.028*
6. Hatcher DC. Operational principles for cone-beam computed tomography. The J American Dent Assoc 2010; 141:3S-6S. *https://doi.org/10.14219/jada.archive.2010.0359*
7. Baheerati M, Don K. Applications of cone-beam computerized tomography in dental practice: A brief review. Drug Inv Today 2019; 11.
8. Horner K, Islam M, Flygare L, *et al*. Basic principles for use of dental cone beam computed tomography: consensus guidelines of the European Academy of Dental and Maxillofacial Radiology. Dentomaxillofac Radiol 2009; 38:187-195. *https://doi.org/10.1259/dmfr/74941012*
9. Vandenberghe B, Jacobs R, Yang J. Diagnostic validity (or acuity) of 2D CCD versus 3D CBCT-images for assessing periodontal breakdown. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007; 104:395-401. *https://doi.org/10.1016/j.tripleo.2007.03.012*
10. Pauwels R, Cockmartin L, Ivanauskaité D, *et al*. Estimating cancer risk from dental cone-beam CT exposures based on skin dosimetry. Phys Med Biol 2014; 59:3877-3891. *https://doi.org/10.1088/0031-9155/59/14/3877*
11. Kapila S, Conley RS, Harrell WE, Jr. The current status of cone beam computed tomography imaging in orthodontics. Dentomaxillofac Radiol 2011; 40:24-34. *https://doi.org/10.1259/dmfr/12615645*
12. Anderson PJ, Yong R, Surman TL, *et al*. Application of three-dimensional computed tomography in craniofacial clinical practice and research. Aust Dent J 2014; 59 Suppl 1:174-185. *https://doi.org/10.1111/adj.12154*
13. Gahlot M. A CBCT Study to Assess the Volumetric Analysis of Airway, Craniofacial Morphology and Cervical Vertebral Fu-sion Anomalies in North Indian Patients with Obstructive Sleep Apnea. EC Dental Science 2019; 18:303-320.
14. Jaju PP, Jaju SP. Cone-beam computed tomography: Time to move from ALARA to ALADA. Imaging Sci Dent 2015; 45:263-265. *https://doi.org/10.5624/isd.2015.45.4.263*
15. Bhatia S, Kohli S. Cone-beam computed tomography usage: An alert to the field of dentistry. Imaging Sci Dent 2016; 46:145-146. *https://doi.org/10.5624/isd.2016.46.2.145*
16. Ezoddini Ardakani F, Sarayesh V. Knowledge of Correct Prescription of Radiographs among Dentists in Yazd, Iran. J Dent Res Dent Clin Dent Prospects 2008; 2:95-98. *https://doi.org/10.5681/joddd.2008.020*
17. Shetty SR, Castelino RL, Babu SG, *et al*. Knowledge and attitude of dentists towards cone beam computed tomography in Mangalore–a questionnaire survey. Austin J Radiol 2015; 2:1016. *https://doi.org/10.18502/fid.v16i5.2292*
18. Hatcher DC, Dial C, Mayorga C. Cone beam CT for pre-surgical assessment of implant sites. J Calif Dent Assoc 2003; 31:825-833. *PMID: 14696834*
19. Kobayashi K, Shimoda S, Nakagawa Y, *et al*. Accuracy in measurement of distance using limited cone-beam computerized tomography. Int J Oral Maxillofac Implants 2004; 19:228-231. *PMID: 15101594*
20. Rai S, Misra D, Dhawan A, *et al*. Knowledge, awareness, and aptitude of general dentists toward dental radiology and CBCT: A questionnaire study. J Indian Acad Oral Med Radiol 2018; 30:110. *https://doi.org/10.4103/jiaomr.jiaomr_115_17*
21. Aditya A, Lele S, Aditya P. Current status of knowledge, attitude, and perspective of dental practitioners toward cone beam computed tomography: A survey. J Oral Maxillofacial Pathol 2015; 3:54.*https://doi.org/10.4103/2321-3841.157524*
22. Chau AC, Fung K. Comparison of radiation dose for implant imaging using conventional spiral tomography, computed tomography, and cone-beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009; 107:559-565. *https://doi.org/10.1016/j.tripleo.2008.11.009*
23. Balabaskaran K, Srinivasan A. Awareness and attitude among dental professional towards CBCT. IOSR J Dent Med Sci 2013; 10:55-59.
24. Kamburoglu K, Kursun S, Akarslan ZZ. Dental students' knowledge and attitudes towards cone beam computed tomography in Turkey. Dentomaxillofac Radiol 2011; 40:439-443. *https://doi.org/10.1259/dmfr/21915689*
25. Zain-Alabdeen EH, El Khateeb SM. Comparison of knowledge and perspectives toward cone-beam computed tomography among dentists in three Middle East regions: A cross-sectional study. Saudi J Oral Sci 2018; 5:3. *https://doi.org/10.4103/sjos.SJOralSci_47_17*
26. Bhagat B, Nagrik A, Yemle S. Dental Practitioners' Awareness, Knowledge and Attitude towards Cone Beam Computed Tomography. IOSR J Dent Med Sci 2016; 15:33-37. *https://doi.org/10.9790/0853-15333337*
27. Reddy RS, Kiran CS, Ramesh T, *et al*. Knowledge and attitude of dental fraternity towards cone beam computed tomography in south India–A questionnaire study. Indian J Dent 2013; 4:88-94. *https://doi.org/10.1016/j.ijd.2012.10.003*
28. Riley JL 3rd, Gordan VV, Rouisse KM, McClelland J, Gilbert GH; Dental Practice-Based Research Network Collaborative Group. Differences in male and female dentists' practice patterns regarding diagnosis and treatment of dental caries: findings from The Dental Practice-Based Research Network. J Am Dent Assoc. 2011; 142(4):429-440. *https://doi.org/10.14219/jada.archive.2011.0199*
29. Strindberg JE, Hol C, Torgersen G, *et al*. Comparison of Swedish and Norwegian use of cone-beam computed tomography: A questionnaire study. J Oral Maxillofac Res 2015; 6:e2. *https://doi.org/10.5037/jomr.2015.6402*